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Exploring illustration styles for materials used in visual resources for people with aphasia

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Abstract

Images are often used in cueing therapy and other kinds of rehabilitation activities for people with an acquired brain injury. This paper presents a small-scale pilot study, which explores the appropriateness of different styles of illustration applied to visual resources used in combination with assistive technologies for people with aphasia. The study is part of a larger multidisciplinary project exploring how assistive technologies can be used to facilitate maximal engagement with rehabilitation and to facilitate communication and reengagement with hobbies and leisure activities. The study explored participants' preferences and impressions of the materials with a view to informing design choices made for resources developed for the larger project.

Three participants with aphasia participated in a focus group in which they were shown examples of materials developed as resources for cueing therapy and lifestyle activities. Four sets of illustrations varying in visual complexity – from icons with no context to illustrations with developed backgrounds – were shown at two sizes (A3 and A4). Participants shared their impressions of ease of use and their preferences for different levels of visual complexity in the illustrations, as well as changes in format and layout (combinations of six, nine and 12 images per board).

Based on previous research and existing guidelines for good practice, we had anticipated that participants would find the contextualised examples more meaningful. However, our findings highlighted that participants preferred simple, icon-style illustrations rather than those with contextual detail. Participants' comments suggested that familiarity with this style of illustration – based on their everyday engagement with mobile interfaces – was a likely explanation for this.

Keywords

aphasia, assistive technologies, cueing therapy, icons, illustration, pictorial language

1. Background and rationale

1.1 Project background

The pilot study presented in this paper considers the role of images used in resources designed to support cueing therapy and everyday communication activities for people with an acquired brain injury (ABI). This includes individuals who live with the long-term consequences of stroke or traumatic brain injury and, in our particular study, people with aphasia – an “umbrella term to cover all types and severities of the language processing difficulty” (Pearl, 2014: 10).

The study is part of a larger, multidisciplinary research collaboration involving researchers in Biomedical Engineering, Clinical Language Sciences and Typography & Graphic Communication. This larger project is exploring how a range of assistive technologies can support the rehabilitation and lifestyle needs of people with an ABI. The project involves the development and evaluation of resources that people with aphasia can use to aid their recovery in hospital or at home. Examples include resources using near frequency communication (NFC) tags with mobile devices and a low cost portable system that uses a Kinect gameplay therapy tool that can be targeted to the rehabilitation needs of a patient (Wairagkar, *et al.*, 2017). The tags are used to create responsive cueing therapy boards, information cards that can be placed around the house to help people perform everyday tasks, and functional accessories like key-rings and wristbands that people can wear and use to communicate if they need help. The tags enable individuals to use their mobile phone to activate functions or sounds associated with particular images. For example, they could automatically dial the number of a personal contact or let a carer know they are thirsty by activating a recorded statement.

All of these resources incorporate images. The pilot study presented in this paper considers the appropriateness of different kinds of illustration and changes in visual presentation for people who are engaging in rehabilitation activities for aphasia following an ABI. The aim of the study was to inform decisions about what kinds of images would be most appropriate for resources developed for the wider project, drawing on Houts *et al.* (2006) who recommend including the intended audience in the development of images for medical contexts. In particular, we were interested in assessing participants’ preferences for illustrations that differ in terms of visual complexity. The primary aims of our study were to identify: (1) what kinds of illustrations participants preferred for a set of illustrations that are similar in graphic style but exhibit different levels of contextualisation and (2) the appropriate scale and combination of images to use in boards developed for the larger research project.

1.2 Theoretical foundations

A number of studies support the use of pictograms in healthcare contexts such as medicine leaflets and other kinds of patient information. Barros *et al.* (2014) provide an overview of such studies and, of course, there are examples that have been published in previous issues of this journal (e.g. Zender and Cassedy, 2014; Patton *et al.*, 2015). Much guidance for designing pictograms and icons highlights the importance of simplicity and familiarity (Black 2017; McDougall *et al.* 2000). Zender and Mejía (2013) note that it is important to ensure an appropriate level of detail is provided to ensure meaning is clear and unambiguous.

Studies about the use of pictures in healthcare resources similarly suggest that it is important to minimise distracting details within images (Houts *et al.* 2006). However,

in particular medical contexts, the appropriate level of detail may vary in relation to the specific needs of the individuals concerned. For example, guidelines for the presentation of visual materials for people with aphasia tend to suggest that images need to be presented in context rather than as decontextualised icons. For example, the Aphasia Alliance (2012: 3) suggest that for activities like making a cup of tea, showing the activity (someone making tea) rather than a picture representing an object associated with the activity (a cup of tea) is more helpful. Icons and very simplified images, according to aphasia-friendly design guidelines, do not give enough information about the concept and therefore can be more difficult for people with aphasia to understand than images with narrative context.

These guidelines are supported by research that considers, for example, what “visuographic features people with chronic aphasia perceive as helpful” (Knollman-Porter *et al.*, 2016: 273). Some health communication studies suggest that images with more context or detail can take longer to process (e.g. Ellis and Morrison, 1998). However, Meteyard and Bose (2018) note that studies specifically involving participants with aphasia (PWA) either show no difference between pictures that are more or less visually complex (Nickels and Howard, 1995) or suggest that having more visual detail is helpful and improves recognition (Cuetos *et al.*, 2002). Thus, there is variability in the results and recommendations arising from research in this area.

Using relevant images is a general recommendation for health communications for older adults (McHugh Sanner, 2003). In particular, photography is considered to be very effective in rehabilitation activities because it enables the resources to have a high degree of personalisation or “personal relevance” that may aid the “processing of symbolic information” for people with aphasia (McKelvey *et al.*, 2010: 32). However, general guidelines for health education resources arising from research suggest that line drawings may be more effective than photographs in aiding comprehension (Rose *et al.*, 2011). Thus, Rose *et al.* (2011) suggest that it is important to consider the appropriateness of different kinds of images for people with aphasia.

Knollman-Porter *et al.* (2016) compared four kinds of colour images: icon, portrait photograph with no context, high-content photograph with contextualising background and low-content photograph with contextualising background. They report that participants in their study indicated a preference for “high context photographic images” (Knollman-Porter *et al.* 2016: 273) that include backgrounds to contextualise an image. However, other studies comparing different styles of visual representation have variable results. For example, Rose *et al.* (2011) found no significant differences between resources with photographs, line drawings or no illustrations used in printed educational materials for people with aphasia, although some participants indicated a preference for photographs (suggesting that these made reading quicker or easier). In comparison, in a study focused on narrative retell, Griffith *et al.* (2014) noted that while participants seemed to refer to photographs more than line drawings, they reported both photographs and line drawings to be helpful.

From a graphic communication perspective, research in this area may not be adequately considering the subtleties of visual and pictorial language. In this respect, some studies may not control the role of colour across different test conditions sufficiently. In the Rose *et al.* (2011) study, for example, their findings could also be related to the presence and absence of colour, as the line drawings were shown in black and white. In other studies, where all materials are shown in colour, the photographs often have more naturalistic, authentic colour palettes whereas the

illustrations tend to have very stylised colour palettes with limited modulation of colour (e.g. McKelvey *et al.* 2010; Griffith *et al.* 2014).

In addition, the style of illustrations used in these studies may be relatively stylised and less naturalistic than the photographs they are compared with. Preferences for photographs could also be related to participants' impressions that the style of illustration is patronising, unprofessional or inappropriate (e.g. more suited to children than adults). Thus, even when the inclusion of colour has been controlled in the study, there may also be substantial differences in overall visual style and the level of detail and naturalism that could influence results. For example, the Knollman-Porter *et al.* (2016) study does not include any forms of illustration that could have an equivalent level of detail to the photographs used. In this respect, the icon condition in their study is substantially distinct from the three photographic conditions and may seem like the odd one out.

Overall, it seems that the materials used in many of the studies exploring the role of images in visual resources for people with aphasia often overlook how different styles of visual representation may differ substantially in quality, perceived professionalism or carry particular genre associations. Photographs, line drawings and icons, from a graphic communication perspective, are substantially different pictorial forms. Accordingly, the exploratory study presented here explores PWA preferences for different levels of visual complexity in illustration, with a view to identifying what level of detail we should include in any visual resources developed for the on-going project that considers particular remedial and everyday applications of images.

For the purposes of identifying appropriate images to incorporate into our research materials, we decided to explore whether participants still express a preference for highly-contextualised images rather than icons when all the images shown are illustrations and when these are developed to a higher standard of illustration rather than resembling clip art illustrations. Interestingly, the importance of using images of a professional standard, rather than generic clip art seems to be increasingly recognised as a number of recent studies have included or consulted graphic designers within their research teams (e.g. Kheir *et al.* 2014; Van Beusekom *et al.*, 2015).

2. Methods and materials

2.1. Participants

A focus group explored participants' impressions of ease of use and their preferences for different visual examples. The participants were recruited from the patient and public involvement group of the larger research project. In this respect, the participants can be considered to have an on-going interest in the project and in assistive technologies. Three people with chronic aphasia and one care-giver (the partner of a PWA) attended the focus group. The participating individuals with aphasia (all more than three years post-stroke) were able to express their views verbally and with sufficient comprehension to follow and contribute to a group discussion with support.

Given the exploratory nature of the focus group and its relationship to the larger project, the slightly small number of participants is sufficient as a starting point to consider what kinds of materials (in terms of illustrative style and format) to develop for further evaluation. It is also appropriate for a focus group involving people with aphasia – these individuals often find large group conversations very challenging and

require support to communicate their ideas. The small sample has precedent in other small studies involving people with aphasia (e.g. Knollman-Porter *et al.*, 2016 – six participants; Griffith *et al.*, 2014 – four participants) and other preliminary studies conducted as part of this project (Wairagkar, *et al.*, 2017 – three). However, for any subsequent studies where we may need to evaluate the usability and effectiveness of particular images or are seeking more generalisable results, we would aim to recruit a slightly larger number of participants or conduct more than one focus group.

2.2. Materials

We considered participants' preferences for three attributes:

1. the different levels of visual complexity applied to a set of illustrations
2. the number of images presented in combination (six, nine, or 12).
3. the size of the boards on which the images were presented (A3 or A4).

Participants were shown a range of illustrations presented in sets to replicate the sorts of boards that could be used in cueing therapy activities or as personal communication aids at home. The boards were presented in combinations of six, nine or 12 images and participants were also given an opportunity to compare A3 and A4 sized resources. In addition, participants viewed some examples of the illustrations used in functional accessories (e.g. key-ring and wristband) and a customisable board (*Figure 1*) which allowed participants to place or remove the images (according to how often they may wish to use an image). This enabled us to consider some of the different visual applications using NFC tags that are being incorporated into the larger research project.

[insert Figure 1]



Figure 1: The illustrations were applied to resources such as customisable boards in which users can select concepts or functions which they are likely to use more frequently in their daily lives.

All resources were developed and presented in full colour. The materials were printed on a white card stock of 250gsm. This card is resistant but light, ensuring the materials were easy for participants to handle without being either flimsy or heavy.

Two standard sizes were chosen for the boards: A3 and A4. Each participant was given a set of A4 resources to look at and then the A3 boards were displayed to facilitate group discussion.

The use of labels and text presented across all the boards was standardised. The resources were designed with reference to guidance outlined by the Stroke Association (Herbert, 2012) and the Aphasia Alliance (2012) which support: the use of a large font size, using a sans-serif typeface, and having sufficient white space around images to keep each image distinct.

We developed materials including four kinds of illustration, systematically varied and applied to a set of 12 concepts. These concepts were selected from concepts that were already being used in the wider multidisciplinary project; specifically, they all represent functions or recorded statements that NFC tags could trigger for a person using a hand-held mobile device. Individuals became familiar with all concepts at the start of the focus group, through direct demonstration of the NFC technology. The concepts used in the focus group are shown in Table 1.

Table 1: Concepts illustrated in the cueing therapy boards used in the study		
1. Watch TV	5. Look at a map	9. I am thirsty
2. Make a phone call	6. Turn off the alarm	10. I love you
3. Access email	7. I need the bathroom (toilet)	11. Open calendar
4. Send a text message	8. Open a website	12. Open photos

Four styles of visual variation were applied to these concepts:

- **Set A:** An object representing the action, in an icon style (Figure 2a)
- **Set B:** An object representing the action, in a naturalistic style (Figure 2b)
- **Set C:** A hand holding an object representing the action, in a naturalistic style (Figure 2c)
- **Set D:** An object representing the action being used in context, in a naturalistic style (Figure 2d).

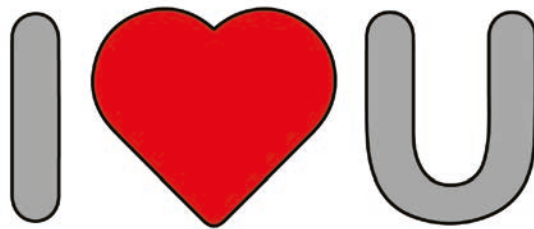
[insert Figure 2a–d]



Figure 2: The changes in visual variation applied to the test materials: (a) object in icon style, (b) object in naturalistic style, (c) hand holding object, and (d) object shown in context.

The only exception was the presentation of "I love you" (Figure 3), which was kept consistent in icon style across the conditions given its more abstract meaning. As a frequent phrase that was likely to be used in the resources developed as part of the wider study, our team decided it was important to include this in the materials even though it was going to be controlled across all conditions.

[insert Figure 3]



I love you

Figure 3: "I love you" – this image represented an emotion so was not varied across the conditions.

Adding in the hands and context meant that the critical object in the illustrations became smaller in these conditions, particularly as we were aiming to keep the overall size of each image reasonably consistent. Our material design process aimed to balance these issues of scale, and ensure that in addition to keeping each critical object distinct, the overall visual weight of the illustrations and amount of white space surrounding the illustrations in each set was as consistent as possible.

As shown in Figure 4, the naturalistic style of drawing was less geometric and stylised than the icon style. The icons also applied colour in a slightly more flat, saturated way (in comparison to the more naturalistically shaded colours in the other examples).

[insert Figure 4]

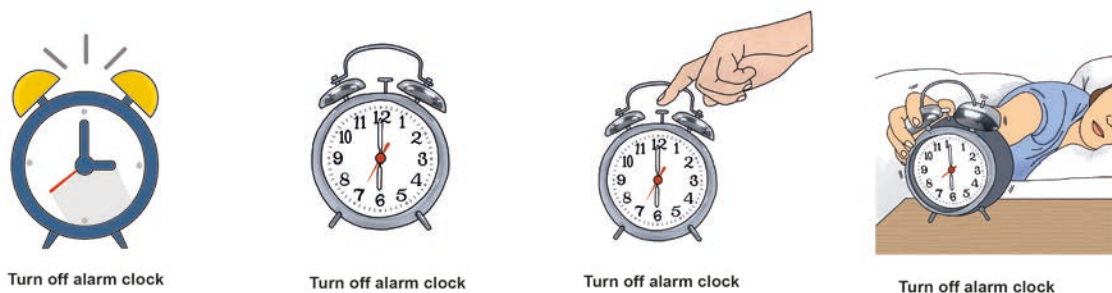


Figure 4: The four styles of visual variation used in the study, as applied to the "Turn off the alarm" concept.

2.3. Procedures

The focus group facilitators included researchers who are experienced in working with people with aphasia and could provide a supportive communication environment. This ensured that, for example, the interviewers could provide participants with adequate clarification of questions, confirm responses and facilitate discussion, allowing each participant to contribute equally in a supportive environment.

Participants were introduced to the concepts at the start of the focus group and shown how the phone would be triggered to do things. So, when they were shown the different images to decide upon, they were familiar with what those images needed to represent.

Participants were asked specific questions as well as being given the opportunity to make general suggestions for how the design of the resources could be improved. The group was asked the following questions (in order):

- What images are easiest to understand? Why?
What do you think the images mean?
- What looks better visually? And why?
- Which layout do you prefer? And why?
- Which would you feel most comfortable using when at home or when out and about?
- Is there anything you would change?

Each individual was given a copy of the questions to refer to, in order to support their comprehension and follow the discussion. For each question, a researcher (LM) presented the question verbally and directed individuals' attention to it on the printed sheet. Responses were then invited from the whole group. If any individuals had not given a response, the researcher asked that individual directly for their opinion. The researcher then presented a verbal summary of what had been said, and asked participants if that were accurate. If not, clarification was sought from the participant. Participant responses were transcribed during the session and the discussion was audio recorded. Responses from the three PWA were summarised against the questions and follow up questions that were asked during the discussion (see Results). Responses from the care-giver have not been included. This individual took part in the discussion but made clear that since they would not be the one using the icons day to day, they felt their opinion was less important than that of the PWA.

3. Results

What images are easiest to understand? Why?

What do you think the images mean?

Two participants agreed that Set A was the easiest to understand. Participant 1 liked the way this was understandable at a glance and felt they could take all the information in at once because only the most essential characteristics of the objects were represented. Participant 2 noted that the icons on Set A were similar to those they were used to seeing on their mobile phone and therefore the familiarity made these easier to understand. The third participant thought that both Set A and Set C were easy to understand. In particular, they suggested that for concepts that were more complicated the detail of the hand in Set C was helpful.

All three PWA said that they found Set D, the board with the most context to be the hardest to understand. As shown in Table 2, their reasons for this shared observation were similar, with all three PWA indicating that it made it harder to distinguish the main idea being represented.

Table 2: Reasons expressed for difficulties with Set D		
Participant 1	Participant 2	Participant 3
Said images gave too much information – some of this information was considered unnecessary and had the effect of diluting the intended focus of the picture	Did not know what part of the image to focus on and could not associate the image with one single idea	Thought each image might have been expressing more than one idea and found it difficult to identify the single concept that the picture was aiming to represent

Follow up question: are there any images that you think are confusing?

Three examples were identified:

- Participant 1 suggested that the clarity of the alarm clock icon would be improved if it had numbers instead of small dots representing the hours
- Participants 2 and 3 both suggested that the “open photos” image was potentially confusing. Participant 2 suggested that this one was clearer on Set D (the board with the most context) because it looked more like a real photo of two people.
- Participant 3 noted that the map icon (Figure 5) was potentially confusing as apart from the representation of it folding and the location symbol it did not have anything similar to a real-life map (such as roads), while the other boards did include such elements.

[insert Figure 4]



Look at map

Figure 5: The map illustration in Set A (icon style).

What looks better visually? And why?

Participants 1 and 2 agreed that they liked the style of the icons in Set A the most. Participant 1 liked the icons because they found these to be clear and they preferred the simplicity of the shapes and colours. Participant 2 noted that they thought the icons in Set A seemed less “patronising” than the images on the other boards. In contrast, Participant 3 expressed a preference for the more naturalistic illustration style of the other materials although they indicated that it was “frustrating” that they did not understand the concepts represented in this. Overall, they preferred the icon board, as this one was easier to understand.

A follow up question was asked: on which board do you like the style of the illustrations the least?

Participant 1 stated that they did not dislike any of the styles presented but that they found the boards with a more naturalistic style to be more confusing and sometimes patronising. Similarly, Participant 2 suggested they found the board with more context to be potentially patronising. However, they explicitly attributed this to the amount of information shown rather than the style of the illustrations. Participant 3 noted that even though they liked the more naturalistic style on the other boards, the board with more context came across as patronising.

Which layout do you prefer? And why?

Follow up question: Do you prefer the bigger (A3) or the smaller size (A4)?

All three PWA agreed that the icon illustrations in Set A were sufficiently visible at the smaller size. One participant also suggested that they would prefer them to bigger but noted that the bigger boards were more difficult to handle. One participant suggested that for Sets B–D the bigger size may be more appropriate, especially for Set D where more context was shown.

Follow up question: How many images do you think we should have on each board?

All three PWA agreed that nine was the appropriate number of images and a more “friendly” approach. They indicated that the boards with only six images on them seemed potentially patronising whereas those with 12 images were overwhelming and made it more difficult to focus on one at a time.

Is there anything you would change?

In response to this question, participants reiterated the suggestions they had made in relation to the images they found confusing. Overall, their suggestions focused on including helpful details to improve the clarity of images at a glance: changing the dots on the alarm clock to numbers, ensuring the photograph behind the camera was not blank, and adding realistic details to the map.

Which would you feel most comfortable using when at home or when out and about?

Participants expressed positive responses towards the examples of wearable technologies that they were shown in the focus group. In particular, they all agreed the key ring was what they found more useful for its apparent advantages when carried around as well as its discretion. They agreed the customisable board was more useful in a home environment as it was easy to find. However, they suggested that

having to carry this around could be less convenient and uncomfortable. All participants agreed that these objects could help them in their everyday lives.

4. Discussion

Contrary to what we had anticipated based on previous studies, participants expressed a clear preference for Set A – the illustrations that were most like icons and which they said they generally found easier to understand. A potential explanation for this result could be related to how the NFC tags enable people to use cueing therapy, activity or communication resources in combination with their mobile phones. In this context, it is possible that icons that are more similar to those used in mobile interfaces and therefore have greater familiarity for participants are perceived as more appropriate. It is also possible that this finding was related to the inclusion of activities that are primarily completed with a mobile phone (e.g. viewing photographs, making a phone call, opening a calendar) and that participants may have different expectations for activities using other equipment (e.g. making tea).

There was a unanimous preference for a small board with nine images upon it. It seemed that this agreement was informed both by participants' impressions that 12 images could be too much for them to process simultaneously and their opinion that the board with only six images was potentially patronising. However, it should be acknowledged that individuals with different levels of aphasia severity or engaging in different kinds of activities at particular stages of their rehabilitation might have different needs or preferences.

Overall, participants' recommendations for improving the examples pointed to the importance of relevant details in enhancing their understanding of images. This finding suggests that contextualising details should be informative details that help clarify the meaning of a graphic rather than details that make an image more complex and potentially more multifaceted. However, given the small sample, the findings are potentially anecdotal and may not be generalisable beyond the scope of this pilot study. It is also possible that in such a small focus group, participants may be more inclined to express agreement.

Nevertheless, from an information design point of view, the difference between our findings and previous studies indicates scope to explore how different levels of visual complexity may have varying levels of appropriateness for different contexts of use and identify what kinds of detail are relevant to include to ensure images are graphically-informative without becoming too complex or distracting. If we are to champion the potential social impact of graphic design, designers need to consider how 'good practice' may be very different in particular contexts of use.

Despite the small scope of this study, it highlights that a 'one size fits all' approach to pictorial language could undermine the effectiveness of visual resources used in real contexts. For empirical research, the arising implications are that research teams need to develop a more nuanced and critical approach to their material design. In this respect, graphic designers and illustrators can play an important role in cross-disciplinary research teams, as can more systematic engagement with the variation and control of materials. This finding is also relevant beyond research for people making tools for others to use, particularly in contexts where people with disabilities need support to achieve basic tasks. While our participants indicated a preference for the simpler, more iconic style of illustration, their comments also suggest that they would find many of the icons more helpful and easier to understand if they included

more precise details. This could suggest that previous studies testing icons or clip art style illustrations used images that were not sufficiently visually informative. In this respect, our findings suggest scope in this field to conduct further studies to identify the appropriate level of detail to achieve the appropriate balance between visual simplicity and visual informativeness for people with aphasia.

Our study takes steps towards ensuring a reasonable level of visual equivalence in the test material created for this pilot study. However, we have not yet sufficiently explored considerations such as differences between the representation of different kinds of concepts. For example, the concepts used in the resources created include actions (turn off my alarm clock, open my digital photograph album), needs (I need the toilet, I am thirsty) and the expression of emotion (I love you). The differences in levels of abstraction and concreteness require more systematic consideration (Black 2017; Zender 2006; McDougall *et al.* 2000).

In addition, it is also important to consider the effectiveness of particular visual representations in authentic contexts of use. The actual effectiveness of the visual resources may be different when used in everyday life to how participants imagine they will use them in a research focus group setting. This aspect has been built into the research design of the larger project, which builds on a series of focus group investigations prior to conducting studies with participants in their homes or preferred environment.

The pilot study findings have been useful in providing direction and guidance to help suggest some considerations we need to bear in mind when developing materials for our on-going investigations into how assistive technologies can benefit people with aphasia. As the focus group chose the icons as their most preferred illustration style, this style is now being used in the second phase of the project. Individuals with aphasia are being set up with NFC technology in their homes, and an individualised board is being created for their use.

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References

- Aphasia Alliance, The. (2012). 'The Aphasia Alliance's top tips for "Aphasia friendlier" communication.' Accessed online August 2017:
<http://www.aphasianow.org/store/files/AphasiaAlliance.CommunicStrategies.pdf>.
- Barros, I. M. C., Alcântara, T. S., Mesquita, A. R., Santos, A. C. O., Paixão, F. P. and Lyra, D. P. (2014). 'The use of pictograms in the health care: A literature review.' *Research in Social and Administrative Pharmacy*, 10: 704–719.

- Black, A. (2017). 'Icons as carriers of information.' In Black, A., Luna, P. Lund, O. and Walker, S. (eds) *Information design: research and practice*: Oxon: Routledge: 315–329.
- Cuetos, F., Aguado, G., Izura, C., and Ellis, A. W. (2002). 'Aphasic naming in Spanish: predictors and errors.' *Brain and Language*, 82: 344–365.
- Ellis, A. W. and Morrison, C.M. (1998). 'Real age-of-acquisition effects in lexical retrieval.' *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 24: 515–523.
- Griffith, J., Dietz, A. and Weissling, K. (2014). 'Supporting narrative retells for people with aphasia using augmentative and alternative communication: photographs or line drawings? Text or no text?' *American Journal of Speech-Language Pathology*, 23: S213–S224.
- Herbert, R. (2012). *Accessible information guidelines: making information accessible for people with aphasia*. London: The Stroke Association.
- Houts, P. S., Doak, C. C., Doak, L. G. and Loscalzo, M. J. (2006). 'The role of pictures in improving health communication: A review of research on attention, comprehension, recall, and adherence.' *Patient Education and Counseling*, 61(2): 173–190.
- Kheir, N., Awaisu, A., Radoiui, A., El Badawi, A., Jean, L., Dowse, R. (2014). 'Development and evaluation of pictograms on medication labels for patients with limited literacy skills in a culturally diverse multiethnic population.' *Research in Social and Administrative Pharmacy*, 10: 720–730.
- Knollman-Porter, K., Brown, J., Hux, K. and Wallace, S.E. (2016). 'Preferred visuographic images to support reading by people with chronic aphasia.' *Topics in Stroke Rehabilitation*, 23(4):259–275.
- McDougall, S. J. P., De Bruijn, O. and Curry, M. B. (2000). 'Exploring the effects of icon characteristics on user performance: the role of icon concreteness, complexity, and distinctiveness.' *Journal of Experimental Psychology – Applied*, 6(4): 291–306.
- McHugh Sanner, B. (2003). 'Are your written materials missing the mark?' *The Journal on Active Aging* 2(4): 18–24. Accessed online June 2018: <http://www.changingthewayweage.com/Media-and-Marketers-support/Articles/areyourwrittenmaterialsmissingthemark.pdf>.
- McKelvey, N.L., Hux, K., Dietz, A. and Beukelman, D. R. (2010). 'Impact of personal relevance and contextualisation on word-picture matching by people with aphasia.' *American Journal of Speech-Language Pathology*, 19: 22–33.
- Meteyard, L. and Bose, A. (2018). 'What does a cue do? Comparing phonological and semantic cues for picture naming in aphasia.' *Journal of Speech, Language, and Hearing Research*, 61(3): 658–674.
- Nickels, L. and Howard, D. (1995). 'Phonological errors in aphasic naming: Comprehension, monitoring and lexicality.' *Cortex*, 31: 209–237.
- Patton, A., Griffin, M., Tellez, A., Petti, M.A. and Scrimgeour, X. (2015). 'Using icons to overcome communication barriers during emergencies: a case study of the Show Me interactive tools.' *Visible Language*, 49(1–2): 80–95.

- Pearl, G. (2014). *Engaging with people who have aphasia: A set of resources for stroke researchers*. London: National Institute for Health Research (NIHR) CRN Stroke.
- Rose, T.A., Worrall, L.E., Hickson, L.M. and Hoffmann, T.C. (2011). 'Exploring the use of graphics in written health information for people with aphasia.' *Aphasiology*, 25(12): 1579–1599.
- Van Beusekom, M., Bos, M., Wolterbeek, R., Guchelaar, H-J. and Van den Broek, J. (2015). 'Patients' preferences for visuals: Differences in the preferred level of detail, type of background and type of frame of icons depicting organs between literate and low-literate people.' *Patient Education and Counseling*, 98: 226–233.
- Wairagkar, M., McCrindle, R., Robson, H., Meteyard, L. Sperrin, M., Smith, A. and Pugh, M. (2017) 'MaLT – combined motor and language therapy tool for brain injury patients using Kinect.' *Methods of Information in Medicine*, 56(2): 127–137.
- Zender, M. (2006). 'Advancing icon design for global nonverbal communication: or what does the word 'bow' mean?' *Visible Language*, 40(2): 177–206.
- Zender, M. and Cassedy, A. (2014). '(Mis)understanding: icon comprehension in different cultural contexts.' *Visible Language*, 48(1): 68–95.
- Zender, M. and Mejía, M. (2013). 'Improving icon design: through focus on the role of individual symbols in construction of meaning.' *Visible Language*, 47(1): 66–89.

Biography

Carmen Martínez-Freile graduated with a BA (Hons) Graphic Communication from the Department of Typography & Graphic Communication at the University of Reading (UK) in 2018. Supervised by Dr Jeanne-Louise Moys, she undertook this project as part of the University's Undergraduate Research Opportunities Programme in collaboration with the cross-disciplinary research team working on 'Closing the digital divide and enhancing participation in social and leisure activities for individuals with acquired brain injury through near field communication technology'. The research team includes: Rachel McCrindle and Maitreyee Wairagkar (Biomedical Engineering), Holly Robson, Lotte Meteyard, and Luke Kendrick (Speech and Language Therapy) and Jeanne-Louise Moys (Typography & Graphic Communication).